COMPETITION IN THE PROCUREMENT OF MILITARY HARD GOODS

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March 1968

P-3796

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I. INTRODUCTION

Competition in defense procurement must be evaluated in terms of specific types of goods and services. Each item the Department of Defense purchases has different competitive potentials and problems. In general, the DOD has been successful in obtaining price competition for goods and services with close civilian counterparts -- clothing, housekeeping supplies, janitorial services and the like. In the procurement of highly specialized military items, however, there are substantial barriers to competition and the DOD has been less successful in obtaining competition.

Of course, procurement difficulties are also encountered in purchasing nonspecialized items. Generally speaking, however, considerable price competition has been obtained for the less specialized goods and services and the DOD, the General Accounting Office and the Congress have been effective in identifying and resolving the problems within the framework of the present procurement system.

It is in the area of specialized military hard goods -- and in the underlying research and development -- that present procurement procedures do not automatically result in a number of independent firms vying for the Government's custom. Competitive problems are often hard to identify, remedial actions are difficult to perceive, and some solutions may call for basic changes in the current procurement system.

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The differential role of price competition among various types of goods and services is easily illustrated by procurement statistics. Table 1 divides Air Force procurements in fiscal year 1966 by type of product and method of selecting the contractor. Note that nearly 50 percent of the total expenditures for "other goods and services" (roughly, the nonspecialized items) involved price competition. In contrast, less than 10 percent of the R&D services, and only 2.6 percent of the complete weapon system expenditures, involved price competition. Note also that the corresponding figure for "other hard goods" is about 30 percent. The class "other hard goods" deals primarily with the reprocurement process; i.e., the procurement of weapon system components, accessories, and support equipment following weapon system procurement and the initial provisioning of replacement parts.

A major issue in defense procurement, therefore, is how to obtain price competition for the specialized military goods and services. A corollary issue is how to protect the public interest in procurements where competition cannot be relied upon for protection. This paper will briefly consider both issues as they emerge in the procurement of specialized hard goods. Attention is focused on hard goods for two reasons. First, competition is relatively prevalent in the soft goods area, except for R&D services. Second, although research and development is largely noncompetitive, the barriers to competition here are so severe that the prospects for significant increases in price rivalry are not encouraging. For hard goods, however, competition is relatively scarce, yet there appear to be feasible methods for obtaining significant increases in price rivalry.

In considering competition in military "hard goods" it is useful to distinguish procurements of complete systems from the reprocurement process that deals with replacement or resupply of weapon system components, accessories, support equipment and other specialized hard goods. This paper will first discuss the reprocurement problem and then turn to the weapon system acquisition problem. A brief discussion of the problems encountered when price competition cannot be obtained is provided at the end of the paper.

Table 1

AIR FORCE PROCUREMENT - FISCAL YEAR 1966[a]
($ Billion and Percent)

Contractor Selection Method	Research and Development		Procurement of Hard Goods: Complete[b] Weapon Systems		Procurement of Hard Goods: Other Hard Goods		Other Goods and Services		Total	
	$	%	$	%	$	%	$	%	$	%
Price competition	0.24	9.3	0.05	2.6	0.77	29.7	0.85	48.9	1.91	21.7
Design or technical competition	0.67	25.9	--	--	0.03	1.2	0.09	5.2	0.79	9.0
Single source after price competition	0.03	1.2	0.32	16.9	0.10	3.9	0.04	2.3	0.49	5.6
Other	1.65	63.7	1.52	80.4	1.69	65.3	0.76	43.7	5.62	63.8
Total	2.59	100.0	1.89	100.0	2.59	100.0	1.74	100.0	8.81	100.0

[a] Compiled from data submitted on DD Form 350, "Individual Procurement Action Report." Only procurement actions for $10,000 or more with business firms in the United States are included. Detail does not always add to total due to rounding.

[b] Includes complete aircraft, helicopters, missiles, spacecraft, and complete aircraft engines and major engine components.

II. COMPETITION IN THE REPROCUREMENT PROCESS

BENEFITS OF COMPETITION

Before examining possible methods of increasing competition, let us consider why we might want more compeition. Of course, there is a general consensus that business competition is a desirable social condition. This consensus is reflected, inter alia, in antitrust laws, procurement statutes and regulations, and in a variety of other public laws and policies. Apart from its general social merits, competition is also believed to yield lower prices to the purchaser. There is persuasive evidence that this is true for military procurements.

In this connection the GAO exhibits presented at many Congressional hearings are relevant. They show savings on the order of 25 percent or more when an item is bought competitively after a previous sole-source procurement. Based on GAO evidence and on studies conducted within the Department of Defense, Secretary McNamara has used the 25-percent estimate for determining savings in shifts to competition when reporting to Congress on his Cost Reduction Program.*

RAND studies have also probed into the cost-savings of competitive reprocurements. Table 2 shows the results of examining variations in the offer prices submitted by firms in competitive situations. The center column shows the results of nearly 2,000 cases of formal advertising in the procurement of aircraft accessories and electrical and electronic components; the third column lists the results of price competition on some of the major C-141 subcontracts let by the prime contractor, Lockheed Aircraft Corporation.

The important feature is the range of offer prices. The statistic denoted "d" is computed by taking the mean bid and subtracting the lowest offer price from an acceptable firm and dividing this by the low bid. Note that in roughly one-third of the cases involving formal advertising the mean bid was 50 percent or more above the low acceptable bid.

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*Secretary McNamara's 1965 report goes into this subject in some detail. See Ref. [18], pp. 12-14. Some relevant GAO reports are contained in Ref. [17].

Table 2

RELATIONSHIP BETWEEN WINNING BIDS & MEAN BIDS

$$d = \left[\frac{\bar{x} - x_{min}}{x_{min}} \right] 100$$

d-Value (%)	Formal Advertising Situations[a]		C-141 Subcontracts[b]	
0-10	416	1355	1	15
10-20	308		3	
20-30	279		3	
30-40	210		5	
40-50	142		3	
50-60	127	613	2	14
60-80	183		5	
80-100	79		1	
>100	224		6	
Total	1968		29	

[a] Based on data summarized in Ref. [6].

[b] Based on data contained in Ref. [7].

Keep in mind that for the most part these variations in bids occurred on contracts for standard commercial items or items common to a number of military systems.

The C-141 subcontracts are particularly interesting since product differentiation was more of a factor. About half of the cases showed a mean bid 50 percent or more above the low bid from a technically acceptable supplier. In 20 percent of the cases, the mean bid was more than twice as great as the low bid. Although not shown in Table 2, the high bids typically exceeded low bids by a factor of 2 or 3 for the C-141 subcontracts.

The point is that one would be surprised not to observe savings of at least 25 percent on average when a supplier is chosen on the basis of price rather than some nonprice criterion, especially if the contractor knew he was in a "lock-in" or noncompetitive situation. In this connection it is important to bear in mind that the wide variation in bids shown in Table 2 occurred when firms knew they were competing against rivals; therefore, some or all of the price quotations may have been lower than they would have been under some other source selection procedure.

PRESENT METHODS OF OBTAINING COMPETITION

Given that there are apt to be substantial cost-savings from more price competition, let us examine how competition is obtained in the reprocurement of specialized military items. Two major barriers hamper the entry of new firms into the production of a specialized part, component or similar hard good. One is that the start-up costs are often so high that new potential manufacturers are uninterested in competing for some specific contract. The second barrier is the possession by the original developer of legal or proprietary rights and "know-how."* Without such technological rights and information, new firms may be unable to produce at an attractive cost.

The Government has attempted to overcome these barriers in several ways. To attack the start-up cost barrier, the DOD has been using a technique called multi-year procurement. In essence, it lets long-term requirement contracts that serve to assure the winner of a source-selection competition that he will have a large volume of business over which to spread costs of entry. This approach has had salutary effects, but its application is limited by the inherent uncertainty of forecasting future military purchase quantities. It also does not deal with the technological barrier to entry.

There are primarily two techniques in use to overcome this latter barrier. One is the establishment of standard military specifications

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*A general discussion of this problem and the policy background is contained in Ref. [9].

for products or the procurement to form-fit-and-function specifications rather than specific configuration or design specifications. Most competition in reprocurement is now obtained in this way. There are inherent limitations, however, on the use of this technique. One limitation is that it can result in the military having to stock a number of items that meet the same form-fit-and-function specifications but which have different physical characteristics and, therefore, require different replacement parts and maintenance procedures. Logistics costs can easily exceed the competitive benefits. Another limitation is that the establishment of standard military specifications is only practical with items having high and recurring demand and well-established physical attributes. In other words, for highly specialized or differentiated items, establishing general specifications can be infeasible or very expensive.

A second current approach to overcoming the technological barrier to competition is to acquire the developer's technical data and then diffuse it among prospective suppliers when and if the Government decides to reprocure the item. The impact of this procedure during 1966 is suggested by a sample of Air Force purchases, the results of which are summarized in Table 3.

The total value of contracts covered in the sample was $172 million. About one-third of this total involved price competition, which is approximately the same as the overall experience of the Air Force Logistics Command during that year. Each of the procurements was screened to determine its competitive potential and the availability of suitable packages of technical data. Turning first to those procurements that were competitive, note that over half of them (in dollar volume) were procured to standard military specifications or to the form-fit-and-function specifications. Of more interest, it is noteworthy that less than $14 million, or about 20 percent, of total competitive procurements could have resulted from the availability of complete data packages. In all other cases the data packages were either incomplete or simply not used.

Turning to the noncompetitive procurements, it is noteworthy that the nonavailability of data packages accounted for less than 25 percent

Table 3

A SAMPLE OF AIR FORCE REPROCUREMENT EXPERIENCE*
($ Million)

Reasons for Noncompetitive Procurements		
Data inadequate or incomplete	25.1	
Proprietary data	5.9	
Urgent procurement	35.6	
Technical reasons other than data	20.2	
Small dollar amounts (not screened)	21.5	
Other	1.5	
Total noncompetitive		109.8
Reasons for Competitive Procurements		
Data package complete	13.8	
Procurement to military specifications or standards	37.8	
All others	10.8	
Total competitive		62.4
Total		172.2

*Compiled by J. W. McKie from data furnished by Warner-Robins Air Materiel Area for FY 1966.

of this total. In fact, the combination of reasons dealing with urgency, technical reasons other than data, and small dollar amounts accounted for the bulk of noncompetitive procurements.

To sum up, about one-third of these procurements were competitive and roughly one-fifth of this one-third, or approximately 7 percent of all procurements, were competitive due to the dissemination of complete packages of technical data to new prospective suppliers. The data on the benefits of competition indicate a significant payoff to the Government of obtaining 20 percent more competition through this method of data dissemination. Even so, it is important to recognize that the cost of obtaining, storing, retrieving and screening packages of technical data must be allocated to a very small fraction of total reprocurements. Obviously, this raises some questions about the cost-benefit relationships in the present policies concerned with technical data and its dissemination.

A more important consideration is the potential for future increases in competition. In cases where the technology necessary for efficient manufacturing is embodied in engineering drawings, present procedures of disseminating packages of technical data should prove effective. In view of the limited use made of reprocurement data, however, there are reasons to question the adequacy of engineering drawings as the sole instrument of technology transfer. Fortunately, commercial experience provides insight into the embodiment of manufacturing know-how and the requirements for efficiency in the transfer process.

INCREASING COMPETITION IN REPROCUREMENT

It appears that any major increase in competition in the reprocurement of technical hard goods will require further innovations in procurement methods. This section will consider the techniques and practices of industry in transferring manufacturing technology and their possible implications for defense procurement policy.

Of course, technology is an abstraction and cannot move. The question is: what actually does move that permits one firm to manufacture technically sophisticated products that have been developed by another firm? Throughout U.S. industry, interfirm transfers of manufacturing know-how have become quite popular in recent years. The magnitude

and growth of international licensing by U.S. firms is shown in Table 4. The table does not distinguish between license payments for patent rights and payments under know-how licenses; however, much of the increase in royalty payments over the past decade has been from know-how licenses.* Therefore, the bulk of the royalty payments shown for recent years have been paid for the transfer of manufacturing know-how. These licenses typically call for royalty payments of 5 percent of the value of licensed production. As a rough estimate, it appears that about $1 billion in royalties was paid to or by U.S. firms during 1966 for manufacturing know-how, technology that resulted in roughly $20 billion worth of licensed production. Placed in perspective, this amount of licensed production currently exceeds the total procurement of hard goods by the defense establishment.

U.S. aerospace firms have been particularly active in the field of know-how licensing. Literally thousands of airframes, aircraft engines, and accessories have been produced by firms not involved in R&D and initial production.** Methods by which technology is transferred between firms varies a great deal. However, in the transfer of production know-how for airframes and aircraft engines, a great deal of information on production techniques and processes is usually provided.*** In addition to engineering drawings, tool design information (or actual tooling), production layout and process information, and technical or engineering assistance are almost always included. In a recent survey, officials of a number of aerospace firms were asked to describe policies and practices relating to transfers of manufacturing know-how under license.**** One question that was raised concerned

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*The distinction between patent licensing and know-how licensing is somewhat arbitrary because know-how licenses cover not only the technology but also any underlying patent and proprietary rights. In the case of know-how licensing, technology is viewed as the principal ingredient even though underlying rights to the technology are included.

**Table 5 summarizes data on aircraft co-production programs.

***A discussion of techniques by which know-how was transferred between U.S. and Japanese firms in various co-production programs is provided in Ref. [5].

****This survey was conducted in 1967 under RAND auspices by Ralph C. Nash, Jr., Associate Dean, National Law Center, George Washington University.

Table 4

INTERNATIONAL RECEIPTS AND PAYMENTS OF ROYALTIES BY U.S. CORPORATIONS, 1957-1966
($ Million)

Year	Receipts from Foreign Firms			Payments to Foreign Firms		
	Affiliated Firms	Other Firms	Total	Affiliated Firms	Other Firms	Total
1957	238	140	378	26	22	48
1958	246	168	414	26	25	51
1959	348	166	514	24	28	52
1960	403	247	650	27	40	67
1961	463	248	711	34	46	80
1962	580	257	837	57	43	100
1963	660	267	927	61	50	111
1964	756	301	1,057	67	60	127
1965	924	301	1,225	67	66	133
1966	1,045	271	1,316	64	73	137
Total	5,663	2,366	8,029	453	453	906

SOURCE: U.S. Department of Commerce, Office of Business Economics

the role of technical assistance agreements used in conjunction with licensing. Almost without exception the responses indicated that various forms of engineering or technical assistance were customary whenever the technology dealt with a complex product. In short, the commercial experience indicates that manufacturing technology is embodied in a good deal more than drawings and specifications.

It is interesting to contrast what is transferred in commercial organizations with the Government's policies of diffusing manufacturing technology in order to increase competition in procurement. In the latter case, it is the policy of the Government to acquire, store, screen, and finally disseminate packages of technical data to prospective suppliers in the reprocurement of aircraft parts and components. Generally speaking, the data package that is disseminated contains only engineering drawings and specifications. In other words, the Government's approach to transferring know-how involves the dissemination of a small portion of those things in which know-how is embodied, judging from the views and practices of industry.

This raises a number of questions about the Government's policies concerned with the dissemination of technical data for reprocurement purposes. Where highly specialized products are to be reprocured, is it reasonable to expect the dissemination of drawings to lower the entry barriers sufficiently to permit competition? Commercial experience indicates that considerably more is required for efficient transfers of know-how when complex products are involved.

Given that present data policies are reasonably appropriate for increasing competition on items of modest complexity, i.e., where manufacturing know-how is embodied largely in design information, how can competition be further encouraged? Here is where commercial licensing experience may have some direct relevance for innovations in defense procurement policy.

The purpose here is not to propose a specific policy innovation, but rather to indicate how commercial licensing experience might be incorporated into procurement policy. Suppose that a condition of an R&D contract with the Government calls for the recipient firm to provide a package of manufacturing know-how to any firm later designated

by the Government to fill a reprocurement contract. The developer would be assured that such know-how licensing would not be required except if he failed to win the follow-on production contract. In other words, a clause would be inserted in the R&D contract providing for the mandatory licensing of all rights and manufacturing technology to any licensee designated by the Government at a later point in the program, should the firm engaged in the R&D fail to win a later production contract. The amount of royalties to be paid would be predetermined and stipulated in the original contract.

When the time came for a follow-on production order, sufficient technical data would be disseminated to prospective suppliers to permit them to submit price quotations. Of course, each prospective new supplier would know the costs of obtaining know-how under license from the previous supplier. The developer, who would be forced to license only after failing to win a competition for a follow-on contract, would have a pricing advantage in the competition equal to the amount of royalty payments that other firms would incur, as well as learning advantages. He would, nonetheless, know he was competing against rivals for the follow-on contract and competitive pressure would result.

This concept has three attractive features. First, for many procurements it would get the Government out of the data business and generally reduce Government involvement with contractors. Second, it avoids the problem of trying to decide exactly what technology is proprietary -- a metaphysical exercise that has occupied too much of the energy of procurement officials. Finally, the main costs of transferring technology would never be incurred unless the buyer were able to realize savings from the transfer over and above the transfer costs.

In sum, further increases in competition in the reprocurement will depend to a considerable degree upon the Government's success in diffusing technology. In this connection there appears to be considerable potential for developing and applying new techniques which will create competition among suppliers of technical hard goods.

III. COMPETITION IN WEAPON SYSTEM PROCUREMENT

Competition in the procurement of major systems poses more severe difficulties than competition in the reprocurement area. Price-competitive source selections are rarer. More conflicts exist between the Government's desire to minimize costs and its desire to speedily introduce high-quality items into service inventories. Nonetheless, the basic problem in weapon system competition is the same as in the reprocurement area. This is the problem of overcoming the barriers to the entry of new firms posed by set-up costs and the lack of manufacturing technology. Despite the difficulties, some competition has been achieved in the weapon system area and there are potentials for achieving more.

THE CONVENTIONAL STRATEGY -- DESIGN AND TECHNICAL RIVALRY

When analyzing weapon system acquisition strategies, it is helpful to divide programs into sequential stages.* A simple division is shown in Fig. 1; programs are divided into three stages: development, initial production, and follow-on production. At some point during the development stage the product becomes reasonably well defined. This point, therefore, divides the development stage into a pre-product definition phase and a post-product definition phase.

In any actual program the stages shown sequentially in Fig. 1 may overlap or blend in with one another. Moreover, for some purposes it is useful to divide programs into more stages. The present purpose is to examine various weapons system acquisition strategies to see how each permits -- or precludes -- competitive source selections at different points in a program. For this purpose the schematic portrayal of programs and strategies in Fig. 1 is sufficient and instructive.

Considering first the conventional strategy (labeled design rivalry in Fig. 1), note that the Government selects a contractor prior to the specification of a well-defined product. What is ordinarily

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*Weapon system acquisition strategies are discussed in more detail in Ref. [5]. For background on competition in weapon system procurement see Refs. [14] and [19].

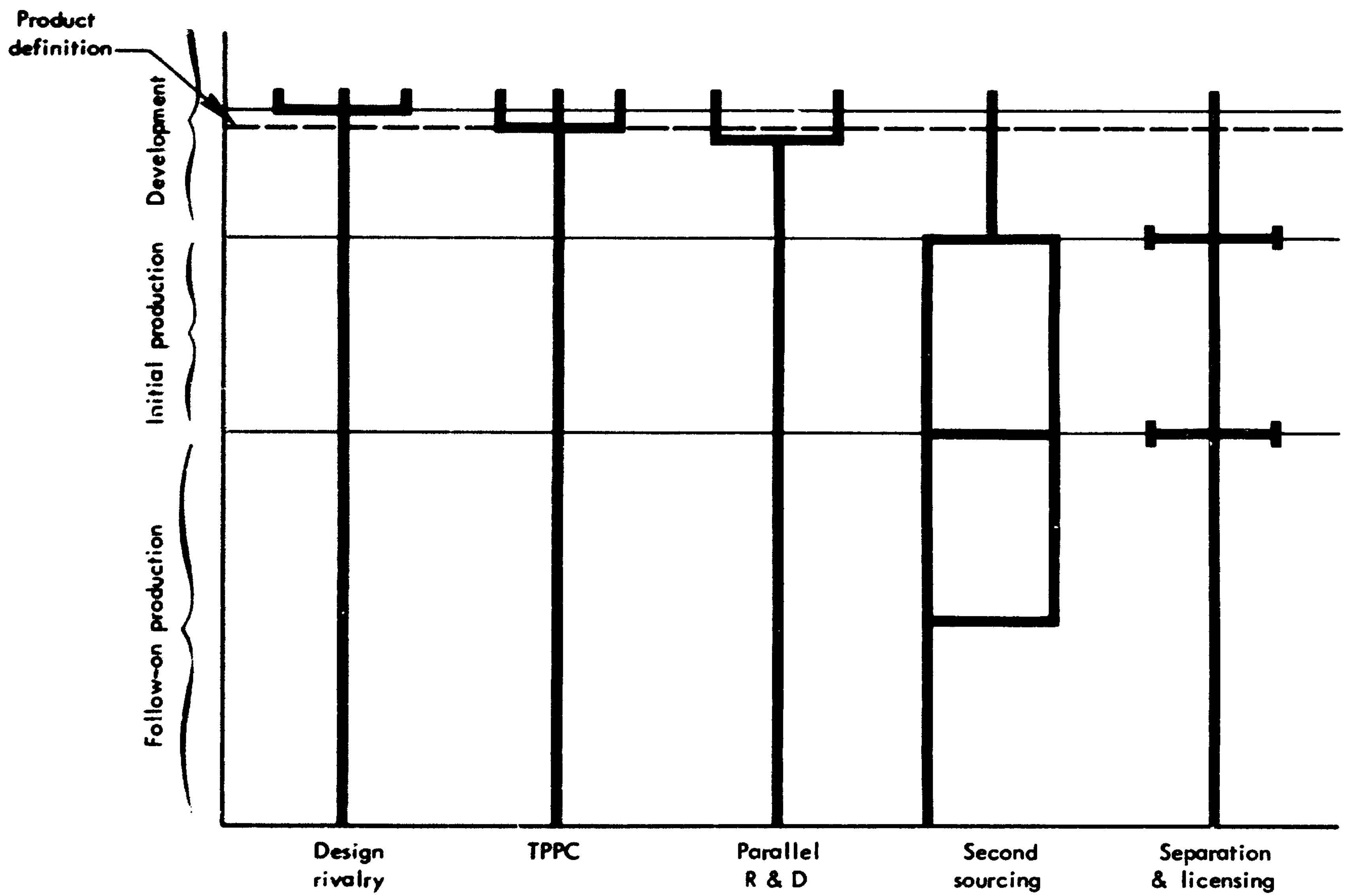

Fig. 1—Acquisition strategies

called a design and technical competition is a misnomer since the technical solutions to meeting operational requirements or solving technological problems are not backed up with demonstration hardware or other convincing physical evidence. (There are methods that could provide a considerably sounder basis for technical choice at the development stage, but this is not the issue at hand.) The important consideration for present purposes is that on the basis of relatively scanty information, with the conventional strategy the Government selects a contractor for the entire program very early in the development stage.

The initial contract, for which the Government has source-of-supply options, ordinarily covers only a small part of the program envisioned, perhaps as little as 10 percent. On the basis of technological and strategic developments as the program progresses, other contracts for different parts of the program are let. These may involve more R&D, initial production of end items and spare parts, and perhaps follow-on production. All the contracts, however, go to the contractor selected for the initial development phase. They are all follow-on, single-source contracts awarded without any new source selection competitions.

This procedure accommodates the high degree of uncertainty surrounding modern weapon system acquisitions.* The uncertainties are of two types. One is technical uncertainty about the physical or performance characteristics of the item to be developed; the other is strategic uncertainty about the demand for the product once it has been produced. Technical uncertainty constrains effective competition early in the development effort, especially when advanced technology is involved. Moreover, both types of uncertainties discourage the Government from making specific long-term production or contract commitments. On the other hand, the Government is interested in having long-term program commitments to increase the likelihood of obtaining funds and to increase the contractor's dedication to the program.

The design rivalry strategy has the advantage to the Government that it does not legally obligate the Government for expenditures beyond those

*These uncertainties are discussed at length in Ref. [14].

covered in the contract for the immediate part of the program authorized. This permits the Government to be flexible with respect to uncertainties. On the other hand, since the developer knows he is to receive production contracts, expenditures can be made early in a program in anticipation of later needs. Tooling, for example, can be constructed at the R&D phase with an eye to later quantity production.

Another advantage to the Government is that the entire program is under the cognizance and control of the same prime contractor. He is responsible for insuring that all technological knowledge gained during one stage is transferred to those units within his firm responsible for later stages. The Government need not be concerned about insuring that knowledge and information acquired in one part of the program is transferred to parties involved in other parts of the program.

There are three difficulties with this strategy. First, in selecting the recipient of the initial development contract, the Government cannot merely choose the best development organization. Instead, it must keep in mind manufacturing as well and select the firm with the best overall capability. The strategy works against firm specialization.

Second, with this strategy R&D is not viewed as an end in itself but as the prelude to more lucrative manufacturing contracts.* This situation creates intangible pressures that make it difficult to terminate less useful projects. Also, since early in the program the contractor begins preparation for production, cancellation of the program or changes in the configuration of the system frequently lead to the scrapping of tooling, plans and so forth. This can prove extremely expensive.

Third, with this strategy most procurement dollars are spent under follow-on contracts without even technical rivalry. If cost-saving benefits from competition in weapon systems are anything like those in the reprocurement area, this results in a substantial increase in weapon system costs.

In short, the uncertainty inherent in weapon system development presents the DOD with three options. The first is to regard competition

*For an exposition of this point by an aerospace industry spokesman, see Ref. [10].

as infeasible or uneconomic at all stages of a program, let the initial contract by a design rivalry, and let all other contracts (accounting for most of the expenditures) as noncompetitive follow-ons. The second option is to attempt to resolve the uncertainties early enough in the program to permit effective price competition at the R&D stage. The third option is to regard uncertainty resolution at the R&D stage as infeasible or uneconomic but to attempt to generate competition later in the program.

The DOD has chosen the first option for most programs since World War II. For some programs, however, the other approaches have been used. Some alternative methods of generating competition are depicted in Fig. 1. Some strategies permit competition at the development stage, while others facilitate competition at later stages in programs. They will be briefly described here.

TOTAL PACKAGE PROCUREMENT*

One way to obtain competition at the development stage is to use the total package procurement concept (TPPC) recently applied to the procurement of the C-5 transport aircraft. This strategy requires elaborate product definition such that uncertainties can be sufficiently resolved to permit a single contract for the entire program to be let with price competition. This is indicated in Fig. 1 by the source-selection at the point of product definition. With TPPC, all procurement dollars are spent in a competitive environment. Follow-on contracts are eliminated. Also, a single contractor has coordination and integration responsibility for the entire program. Transfer of technology among stages is an interfirm matter.

The main problem with applying TPPC is that technological and strategic uncertainties must be largely resolved before the package contract is let. Even for relatively "certain" projects, such as the C-5, this can prove quite expensive. For more advanced systems with greater technical uncertainty, or in situations where there is considerable strategic uncertainty, resolving uncertainties might be impossible or at least prohibitively expensive.

*The concept is described in Refs. [2], [12] and [13].

A possible complication is that TPPC requires the Government to adopt a "hands off" policy towards the system once the contract is let. The contractor has a competitively priced contract for a tightly specified system and revisions have to be authorized and funded by change orders. With extensive changes, to be priced separately by negotiation, the Government will find itself back in the position of negotiating with a single source -- the position it attempted to avoid by using TPPC. Of course, for a system without much uncertainty changes should be few and it is desirable to minimize the Government's involvement with the production. If changes are inevitable, however, either TPPC complicates the process of making them or the changes dilute the usefulness of TPPC.

In short, TPPC is an extremely effective way to achieve competition in weapon system projects with relatively little uncertainty. For projects with a high degree of uncertainty, however, it could be infeasible or expensive to apply.

PARALLEL DEVELOPMENT*

Another approach to generating competition at the development stage is the parallel development strategy. The concept here is to bring along two or more prospective suppliers through the development stage until demonstration hardware has been produced. As shown in Fig. 1, the production contractor is selected later than is the case with a design rivalry or TPPC. With demonstration hardware, presumably enough technical uncertainty will have been resolved to permit cost-effectiveness evaluation of the competing systems. This approach could be combined with other strategies to generate considerable competition even in the face of substantial uncertainty.

The principal obstacle to parallel development is that it adds to the total cost because of the duplicated R&D activities. At least this seems to be the main reason why this approach has not been used in recent years. The costs and benefits of parallel developments and other prototype

*Ref. [8] develops the case for a parallel development strategy.

approaches have received relatively little study, although there are reasons to think that the cost might be lower and the benefits higher than commonly believed. This approach offers a number of attractive features when used in conjunction with other techniques.

The TPPC and parallel development approaches attempt to generate competition in weapon system procurements by reducing uncertainty at the R&D stage. There are other strategies that take an alternative route and attempt to generate uncertainty competition later in the process at various stages of production.

SECOND SOURCING

One of these is "second sourcing," a strategy that has been quite successful for the Navy.* The Navy has applied it to a variety of programs for small missiles, target drones, aircraft engines and torpedos. Usually a development contract is let to a single firm, although in some instances the Navy has designed the weapon in-house. The developer (if Navy-developed, the original producer), furnishes the Government with drawings, specifications and other technical information. The Government performs enough system engineering to validate the data and transfers at least portions of the technology to the new supplier.

During the initial production run or during follow-on production, or during both, there is some form of competition. Sometimes this is negotiated price competition but there have even been advertised procurements. The new or second source sets up a production line. Production by the original and second source may overlap in time, two production lines may be maintained through much of the program, or the original source may drop out of the program with the award of the contract to the new supplier. The second sourcing example shown in Fig. 1 assumes a system developed by a Government organization with two "hot" production lines during the early part of the production process.

This strategy has the advantage that only one development program takes place yet competition is obtained at some manufacturing stage.

*Some second-sourcing experience is discussed in Ref. [16], pp. 190-192.

Also, the Government need not make long-term procurement commitments, but can procure on a year-to-year basis, generating competition through the dissemination of data packages.

There are two disadvantages. First, the Government must engage in extensive system engineering and technology control in order to warrant the design given the second source. This is expensive and requires a sizeable, skilled staff. Second, there is duplication of tooling and other set-up costs. If production runs are large enough to absorb these costs, this may be a negligible consideration. With smaller production runs, such as are typical with ships and aircraft, such costs may be prohibitive.

SEPARATION AND LICENSING

Another interesting procurement strategy is separation and licensing of technology.* The idea is to open a program to competition at one or more points during the production stage, aided by technology licensing of the sort previously discussed in connection with the reprocurement problem. Technology licensing has been an important feature in various co-production programs under which aircraft and missiles have been produced by firms that were not involved in the underlying R&D. Provisions that might permit licensed production were also written into the contract for the Phoenix missile system for the Navy version of the F-111.**

Separation and licensing represents one polar approach to competition in weapon system procurement and TPPC represents the other. With the conventional procurement strategy there are a number of contracts but only one source selection. TPPC deals with the problem by collapsing the many contracts into a single contract; there is one contract and one competitive source selection. With separation and licensing there may be several contracts, but also several opportunities for competitive source selection.

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*In Ref. [5] this strategy is described in more detail and evidence about its costs and benefits is provided.

**This contract clause is described in Ref. [11], pp. 45-46.

The separation and licensing strategy could be tied to a conventional R&D effort or to some other development strategy. The development contract would contain a clause giving the Government the right to designate another firm as the developer's licensee for production of the system. Contract negotiations would include fees for licenses of patents, proprietary rights, know-how and any other technology a new manufacturer might require. Provisions for technical assistance would also be included.

After the system is developed and produced in at least limited quantities, a source selection would be conducted for a follow-on production contract. If some firm other than the developer were selected, the developer would receive royalties and assistance payments for his contribution.

In Fig. 1 this strategy is depicted as a single line to indicate that at any point in the production part of the program only one firm is involved. Points at which competition might occur for follow-on production are indicated by horizontal lines.

There are four attractive features of this strategy. First, there is competition for most of the production program. Second, the Government need not be involved closely with technology transfer; this is an interfirm matter covered by conventional technology licensing procedures and law. Third, quantity production commitments and source-of-supply decisions can be postponed until late in an acquisition program. Fourth, only one system need be developed and most of the duplication of tooling required by second sourcing is avoided.

On the adverse side, however, interfirm technology transfers have costs and pose administrative burdens. Also, the contracts must be carefully written to insure the flow of technology between firms and to give the developer adequate incentive to transfer his know-how.

There has been relatively little licensed production in domestic military programs for major weapon systems, but there is substantial experience with such arrangements in the international market. Aerospace firms have become experts in exporting know-how and establishing other firms in the business of manufacturing systems the former have designed. Table 5 presents figures on international licensing of complete

aircraft systems. It shows that more than ten thousand aircraft have been produced by firms not involved in the underlying R&D work. These aircraft have a total value of over $5 billion. Case studies have indicated that the costs of transferring the technology have not been prohibitively high;* therefore, this could prove to be a way to generate more competition in weapon systems at an attractive cost.

To emphasize an obvious point, no one strategy is appropriate for all procurements. Differences in uncertainty, size of production, the difficulty of transferring technology and other considerations should determine the choice of a strategy. Yet, since World War II there has been a tenacious and almost complete commitment to design rivalry as the acquisition strategy. There have been some exceptions such as the second-sourcing programs, but it is notable that they are exceptions and few. Secretary Charles' development and promotion of TPPC has had the salutary effect of generating attention to acquisition strategies and the possibility of innovation. It has challenged orthodoxy in thinking about acquisition methods. Despite the substantial merits of TPPC, it would be regrettable if any new strategy were to become a new orthodoxy. What is needed is more effort devoted to developing new acquisition strategies, improving existing strategies and trying to determine the best mix of acquisition strategies for a given set of weapon systems. These are the problems that demand much more study and attention than they have received in the past.

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*This seems to have been the experience for transfers to Japan of the manufacturing technology of the T-33A, F-86F and F-104J. These programs are described and a detailed analysis is made of the cost of transfer of the F-104J in Ref. [5].

Table 5

INTERNATIONAL PRODUCTION OF AIRCRAFT UNDER LICENSE, 1950-1967
(Number of aircraft shown parenthetically, $ figures in millions)

Location of Licensor	Location of Licensee	Bombers	Fighters	Other Military	Helicopters	Civilian Transports	Total
U.S.	Europe	--	(1,393) $2,046	(100) $3	(2,183) $294	--	(3,676) $2,343
U.S.	Other	--	(2,532) $1,002	(568) $241	(570) $94	--	(3,670) $1,337
Europe	U.S.	(403) $484	--	--	--	(278) $148	(681) $632
Europe	Europe	--	(899) $365	(669) $109	--	--	(1,568) $474
Europe	Other	(48) $372	(669) $109	--	(100) $20	(44) $66	(861) $567
Total		(451) $856	(5,493) $3,522	(1,337) $353	(2,853) $408	(322) $214	(10,456) $5,353

IV. PROCUREMENT IN THE ABSENCE OF COMPETITION

Earlier portions of this paper have explored opportunities for increasing competition in the procurement of military hard goods. While many improvements are possible, even in the best of all procurement worlds, a sizeable percentage of these purchases will always occur without a background of price competition. Pressures of time, lack of technically qualified firms, and financial requirements, will in many cases produce barriers to competition too great to be overcome at reasonable expense. Consequently, procurement policymakers will always be concerned with substitutes for competition, much the same as they are today. This section will mention a few of the more important techniques. The treatment is sketchy not because the problems are simple -- indeed, they are exceedingly complex -- but rather because the techniques and problems have been discussed previously on numerous occasions.

COST ESTIMATION AND CONTROL

In the absence of competitively determined prices, procurement prices and fees have to be cost-based. Consequently, good cost estimating techniques and a sound data base are vital.* Moreover, cost cognizance and control are necessary to insure that cost estimates have some real bearing on actual cost outcomes.

The DOD and Congress have given extensive attention to the problems of cost estimates in recent years. Substantial sums have been spent to improve costing methodology, new cost reporting systems have been instituted, and the Truth-in-Negotiations Act (Public Law 87-653) has been passed to improve the quality of contractor-provided cost data.

In themselves, these are all useful. If one is in a situation without market price information, he needs any other information he can get. The only problem arises because of the position in some quarters that sophisticated cost analysis can adequately replac ompetition as

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*See Ref. [1] for a discussion of some of the requirements for using cost information to make acquisition decisions.

a source of information. There are two reasons why this view is misguided. First, with variations in prices as large as those observed in competitive defense procurement (see Table 2), it is obvious that cost estimation, even if it could estimate some average price accurately, could hardly be expected to estimate a minimum supply price. The second reason is that cost-based prices and fees, even established by good estimation techniques, have inherently perverse incentives. Higher target costs yield more profits.

Improvements in cost estimating techniques and cost controls are valuable as a second-best substitute for competition. They are not adequate replacements for competition, and the search for improved costing techniques should not distract procurement officials in the search for ways to avoid having to price on the basis of cost estimates.

INCENTIVE CONTRACTING

The most spectacular contracting development during the last decade is the growth in the use of incentive pricing arrangements. Great benefits have been attributed to their use. If the alternative to a fixed-price-incentive or a cost-plus-incentive-fee contract is a cost-plus-fixed-fee contract, then clearly there are significant advantages to incentive pricing arrangements.

On the other hand, cost incentives in contracts are poor substitutes for price competition; incentive fees simply do not yield the same competitive pressures.* They motivate contractors to maximize the cost underrun, i.e., the difference between actual and target costs. Therefore, the contractor is as interested in maximizing the target cost as in minimizing actual cost. After all, an inflated target can be achieved by negotiation whereas reduced actual costs must result from efficiency.

There is some empirical evidence on this point. It appears that many of the reported underruns on incentive contracts are the result of overstated target costs rather than increased contractor efficiency. While incentive contracts help to motivate contractors in situations

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*This point is well developed in Ref. [13].

where interfirm rivalry does not provide such motivation, they offer little compensation for the problems generated by a lack of competition.

PROFIT POLICY

The current DOD profit policy attempts to stimulate contractors to be efficient, assume risks, seek above-average performance, and invest their own capital.* The results, though hard to measure, appear to be mixed. Profit policy links fees to pricing and cost-sharing arrangements in contracts. The impact of profit policy on contractor motivations to improve efficiency and increase private investment is less clear. Undoubtedly considerable improvement is possible, and the DOD is actively studying potential new procedures.

Nonetheless, it is important to note that the DOD profit policy comes into play when prices are based on costs because of a lack of market competition. Thus, procurement profit policy always must carry the albatross of the perverse motives inherent in cost-based fees.**

GOVERNMENT-FURNISHED PROPERTY

In any industry with noncompetitive pricing there are social investment problems. The cost-based nature of negotiated procurement prices raises substantial doubt about the motivations of defense firms to undertake the capital investment needed to provide the industrial base for the military establishment and to introduce cost-reducing innovations.

As a result, the DOD has long been a major supplier of capital assets to the defense industry. In recent years it has tried very hard to get out of its investment role.*** The relative importance of Government-owned equipment and facilities has decreased significantly. Nonetheless, the Government still continues to spend large sums each year on equipment to be used by its contractors.

This Government investment poses some competitive problems. It is not easy to place a contractor with Government equipment on the same

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*See Ref. [15] for a discussion of DOD profit policy goals.

**For more discussion of this point, see Ref. [4].

***See Ref. [3].

basis as a contractor without equipment when they are in a competitive source selection. The collection of rents for private use of the equipment is also a problem.

On the other hand, because the Government is an investor it has had a powerful weapon for promoting innovation and change. The introduction of automated machine tools is a case in point. If the Government is successful in turning over the investment role completely to private firms, in a procurement environment which is largely noncompetitive, it will be more difficult to assure that the defense firms remain technologically efficient.

Even so, there are alternatives to current Government ownership policies that appear attractive. Examples are buy-back provisions, price supports for risky investments, and consortiums for specialized equipment. This is not the place to explore the policy choices. It should be noted, however, that Government investment complicates the achievement of competition in procurement, yet it plays an important role in the technological development of the defense industries in the absence of strong competitive pressures.

V. CONCLUSIONS

In the purchase of military "hard goods" the main obstacles to competition are the entry barriers posed by set-up costs and differential endowments of technology and know-how. Generating more competition in this area of procurement will generally require increasing the scope of contracts (as in multi-year procurements or TPPC), or will require diffusion of technology (as in reprocurement data packages, second-sourcing, and separation and licensing).

The DOD has attempted to devise methods of overcoming the barriers and has been successful in increasing competition in procurement. There remains, however, considerable potential for further increases. The evidence on the cost-saving effects of increasing competition in procurement indicates substantial benefits from such increases. The potential payoff justifies considerable attention to new methods of overcoming the barriers to the entry of new firms into the production of military hard goods.

The main danger is that techniques appropriate for one type of procurement will acquire the sanctity of orthodoxy and be applied to all procurements. Each type of good or service has technical or market peculiarities, and so there is a need for a wide range of procurement techniques and a mixed strategy for obtaining competition. More attention to new techniques and more tailoring of techniques to specific procurements is needed. In the reprocurement of components, parts and support equipment, for example, there appear to be large potential payoffs from adding new techniques to the current arsenal of procedures. One such innovation would be the use of licensing techniques for the diffusion of manufacturing technology. Aerospace firms have had extensive experience with know-how licensing in commercial programs and they are experts in transferring technology. There is no reason why the Government should not take advantage of this expertise to achieve more competition in reprocurement.

In the weapon system area the prime need is to experiment with acquisition strategies other than the conventional design rivalry procedure that results in most procurement dollars being spent under

noncompetitive follow-on contracts with the developer. The total package procurement concept (TPPC) represents a major step in this direction. There is need, however, for more experimentation and more attention to designing or perfecting other strategies. One strategy that appears worthy of experimentation is the separation of different stages of programs and the use of licensing techniques to permit competitive source-selections at the reprocurement stage. Procurement strategies have to accommodate the technical uncertainty and market foibles encountered in various procurement situations. Therefore, it is important to prevent any particular strategy becoming "the" strategy. A mix of many weapon system acquisition strategies is essential if competition in defense procurement is to be promoted effectively.

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